REMARKS

Status of the Claims

Original claims 1-18 have been rejected in the Office Action. Claims 1, 4, 7, 10, 13, and 16 have been amended and new claims 19-22 have been added. No new matter has been entered. After entering of the amendments to the claims, claims 1-22 will be pending. Reconsideration of the Office Action of October 13, 2004 is respectfully requested in view of the above amendments to the claims and the following remarks.

Priority

The claim to priority has been amended to include the patent numbers for several of the parent applications. Also, the Office Action has not acknowledged the claim to domestic and foreign priority. The request for priority was included in the Declaration and Power of Attorney form and the first paragraph of the application. Application at p. 1 para. [0001]. Accordingly, applicants request that the examiner acknowledge the domestic and foreign priority in the next communication.

Claim Rejections - 35 U.S.C. §112

The Examiner has rejected claims 1-18 under 35 U.S.C. § 112 as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

In particular, claims 1-9 have been rejected because they give no units for the variable W. Although applicants believe that the units for W are clear from the specification, applicants have nonetheless amended independent claims 1, 4, and 7 to recite units for W. Accordingly, withdrawal of this rejection under 35 U.S.C. § 112 is requested.

Also, claims 10-18 stand rejected as allegedly being confusing because it is unclear what the relationship between variables is. Although applicants do not agree with this assertion and believe the recited claim language would be clear to one of ordinary skill in the art when reading each claim as a whole, applicants have nonetheless amended independent claims 10 and 13 to more clearly describe the relationship between variables. Accordingly, withdrawal of this rejection under 35 U.S.C. § 112 is requested.

Claim Rejections - 35 U.S.C. §102

Claims 1-2 and 10-11 have been rejected under 35 U.S.C. § 102 as allegedly being anticipated by Wright et al. and claims 1-18 have been rejected as allegedly being anticipated by Jiang et al.

Regarding the rejections of claims 1 and 2 as allegedly being anticipated by Wright et al., Wright et al. teach a heat exchanger which has been designed so that the fluid flowing through the unit does so in a turbulent manner and not with a laminar flow pattern as taught by the present invention. As described in the present application, there are several benefits that the narrow micro-channels design recited in the claims confer. It has been found through research into the cooling of high heat load computer chips that the usage of micro-channels leads to unexpectedly high heat transfer coefficients. It is believed that the reasons for this include the increased impact of surface tension and electric potential effects which lead to earlier transitions from laminar to turbulent flow. The effects of natural surface roughness are also magnified in micro-channel flow and can contribute to the high heat transfer coefficients. The structural features and mathematical approximation recited in claim 1 provide a heat exchanger having a narrow micro-channel design that solve these problems and provides improve heat transfer characteristics, and which is not disclosed or taught by Wright et al.

Also, the thermal resistance of the heat exchanger of the present invention is lower and hence, the overall efficiency is improved over the device disclosed in Wright et al. Heat flux from the walls of the channel into the liquid coolant is optimized when all parts of the channel surface are at a uniform temperature. The design of the heat exchanger recited in claim 1 is such that the lower thermal resistance is achieved through careful consideration of the minimum number of channels/meter N, as defined by the approximation $N=195*W+5$. The narrow width of the channel eliminates the situation where the bulk of the fluid passes straight through a heat exchanger with the heat transfer restricted to a relatively thin film of fluid at the surface. These features of claim 1 is not disclosed or taught by Wright et al.

Further, with respect to claim 2, Wright et al. only teaches the use of fin heights of a minimum 3.2mm. Claim 2 recites a height of each narrow channel being less than about 10mm, including less than 3.2mm. This feature is not disclosed or taught by Wright et al.

Regarding the rejection of claim 10, as admitted by the examiner on page 3 of the Office Action Wright et al. only disclose a channel width of 1.4mm. This channel width falls outside that of what is claimed by claim 10 and therefore claim 10 and its dependant claims (claims 11 and 12) are not anticipated by Wright et al. and withdrawal of this rejection is respectfully requested.

Accordingly, Wright et al. fail to disclose or teach all of the features recited in claims 1, 2, 10, and 11. Thus, independent claims 1 and 10, and dependent claims 2 and 11 are patentably distinct from Wright et al.

Regarding the rejections of claims 1-18 as allegedly being anticipated by Jiang et al., applicants have the following remarks. As a preliminary matter, the Jiang et al, reference has a copyright date of 2001. The present application is a Continuation-In-Part application filed on August 8, 2003 and which claims priority to an application filed October 6, 2000. The material added in the CIP application pertains to the mathematical approximation derived for the experimental results utilizing heat exchangers having various configurations on fin and channel width. As such, applicants submit that the Jiang et al. reference is not prior art as to the various features disclosed in the parent application and recited in the pending claims, such as for example, a thermally conductive base, a thermally conductive cover, thermally conductive walls having a thickness, narrow channels having a width and height, an inlet and outlet end, etc. Therefore, the Jiang et al. reference can not anticipate these recited features in the claims.

Further, it is respectfully submitted that the Jiang et al. reference fails to disclose or teach all the elements of the present claims. Jiang et al. do not anticipate the present claims as the heat exchanger in Jiang is not designed to be used with a thermoelectric heat pump. Claims 1-18 claim a heat exchanger for use with an electronic heat pump. Accordingly, since this limitation of claims 1-18 is not disclosed or taught by Jiang et al., these claims are patentably distinct from Jiang et al. and withdrawal of this rejection is requested for this additional reason.

Also, the exchanger described in Jiang et al is designed to be used as a device for exchanging heat between two fluids. These two fluids flow through the exchanger unit in adjacent layers created by the sandwiching of many foils together with etched or drawn micro-channels. The device disclosed by Jiang et al. does not have a thermally conductive

base, does not have a first surface of the base which is designed to have intimate contact with the heat exchanger, and does not have walls between the cover and the base, but rather only discloses walls between intermediary layers of the heat exchanger. Thus, the claims are patentably distinct from Jiang et al. for these additional reasons.

Furthermore, Jiang et al. do not disclose an exchanger that meets the recited requirement that the heat exchanger has a thermal resistance of less than 0.1C/W for a 40 mm width, as required by claims 3, 6, 9, 12, 15, and 18 because the thermal resistance of the heat exchanger in Jiang et al. is not disclosed. Rather the examiner relies on the quotation of the thermal conductivity of the unit, which seems to relate more to the material it is made up or rather the properties bestowed by a particular configuration of fin height and width.

This thermal conductivity is then converted by the examiner to thermal resistance by inverting and multiplying the distance involved, being 0.04m. When the particular units involved are followed through the inversion and multiplication one does end up with the units for thermal resistance being K°/W (equivalent to C°/W). But, the Jiang et al. reference does not disclose or teach such a conversion to derive such a figure, and also this claimed amount is not affected by fin and channel configuration. Accordingly, claims 3, 6, 9, 12, 15, and 18 are patentably distinct over Jiang et al. for this additional reason and withdrawal of the rejection of these claims based on Jiang et al. is requested.

CONCLUSION

It is respectfully submitted that each and every claim pending in this application patentably defines over the prior art of record. For all the foregoing reasons, Applicants respectfully submit that the instant application is in condition for allowance. Reconsideration of the present Office Action and an early Notice of Allowance are respectfully requested.

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